



Docket No.: I0270.0002/P002

#15/Appeal
Brief
OK
10/29/03

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Sunao Ishizaki

Application No.: 10/050,539

Confirmation No.: 7739

Filed: January 18, 2002

Art Unit: 2853

For: DRIVE CIRCUIT OF INK JET HEAD
AND DRIVING METHOD OF INK JET
HEAD

Examiner: L. Nguyen

APPELLANT'S BRIEF

U.S. Patent and Trademark Office
2011 South Clark Place
Customer Window, Mail Stop Appeal Brief - Patents
Crystal Plaza Two, Lobby, Room 1B03
Arlington, VA 22202

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Dear Sir:

This brief is in furtherance of the Notice of Appeal, filed in this case on June 13, 2003.

The fees required under Section 1.17(f) and any required petition for extension of time for filing this brief and fees therefor, are dealt with in the accompanying TRANSMITTAL OF APPEAL BRIEF.

This brief is transmitted in triplicate.

This brief contains items under the following headings as required by 37 C.F.R. § 1.192 and M.P.E.P. § 1206:

- I. Real Party In Interest
- II Related Appeals and Interferences
- III. Status of Claims
- IV. Status of Amendments
- V. Summary of Invention
- VI. Issues
- VII. Grouping of Claims
- VIII. Arguments
- IX. Claims Involved in the Appeal
- Appendix A Claims

I. REAL PARTY IN INTEREST

The real party in interest for this appeal is:

Fuji Xerox Co. Ltd., a corporation of Japan, residing at 17-22, Akasaka 2-chome, Minato-ku, Tokyo, Japan.

II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

A. Total Number of Claims in Application

There are 7 claims pending in application.

B. Current Status of Claims

1. Claims canceled: 6
2. Claims withdrawn from consideration but not canceled: None
3. Claims pending: 1-5, 7, and 8.
4. Claims allowed: None
5. Claims rejected: 1-8

C. Claims On Appeal

The claims on appeal are claims 1-5, 7, and 8.

IV. STATUS OF AMENDMENTS

Applicant filed an Amendment After Final Rejection on June 13, 2003. The Examiner responded to the Amendment After Final Rejection in an Advisory Action mailed July 11, 2003. In the Advisory Action, the Examiner indicated that Applicants' arguments were not persuasive. Applicant concurrently submits an amendment canceling claim 6 without prejudice.

Accordingly, the claims 1-5, 7, and 8 enclosed herein as Appendix A are the same claims that were pending on June 13, 2003.

V. SUMMARY OF INVENTION

The present invention relates to a driving circuit for an inkjet head using a piezoelectric actuator and a driving method for such an inkjet head. Specifically, the drive circuit in Applicants' claims produces droplets of ink by changing the pressure

in a chamber filled with ink. The pressure in the chamber is changed using a piezoelectric actuator. The piezoelectric actuator is energized by a drive wave form signal produced by a waveform generator. As shown below in Figure 1, (which is a portion of Figure 1 of the present Application) a first input of a power amplifier receives the drive waveform signal and amplifies the drive waveform signal that is used to energize the piezoelectric actuator, i.e., the signal presented to the terminal of the piezoelectric actuator. The piezoelectric actuator is a capacitive load in the circuit below. A feedback loop presents the terminal voltage of the piezoelectric actuator to a second input of the power amplifier.

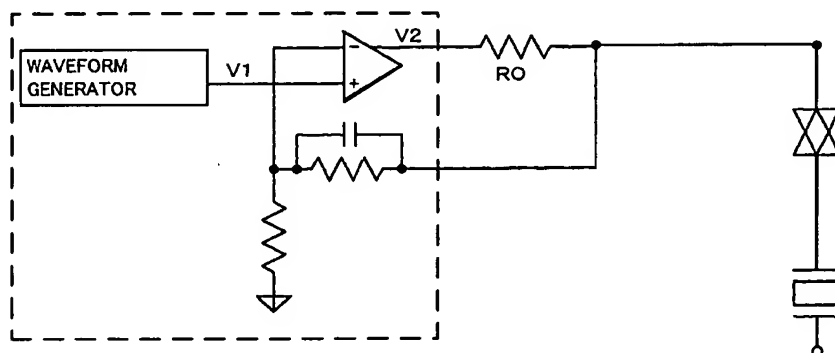


Figure 1

The cable connecting the amplifier to the actuator is a resistive load (R_0). The combination of the resistive load and capacitance of the piezoelectric actuator function as a low pass filter. As such, the drive waveform is modified or dulled due to the low pass filter created by the combination of the cable and piezoelectric actuator. The feedback from the terminal of the piezoelectric actuator to the power

amplifier improves the waveform applied to the piezoelectric actuator. Because the drive signal is fed back to the amplifier from the piezoelectric actuator after load R0, the drive signal applied to the piezoelectric actuator is similar to the output of the waveform generator. In other words, the sharp signal 41 (Figure 4 of the Application) output from the waveform generator is not dulled like signal 42 (Figure 4 of the Application) but is sharp as shown in Figure 7 (of the Application).

VI. ISSUES

A. For the Group I Claims (Claims 1 through 5)

(1) Are the Group I claims patentable over U.S. Patent No. 6,273,538 (“Mitsuhashi”) when considered alone or in combination with U.S. Patent 5,384,583 (“Katerberg”)?

B. For the Group 2 Claims (Claims 6 and 7)

(1) Does the combination of U.S. Patent 6,334,668 (“Isamoto”) in view of Katerberg, proposed by the Examiner, meet the limitations of the claims?

VII. GROUPING OF CLAIMS

For purposes of this appeal brief only, and without conceding the teachings of any prior art reference, the claims have been grouped as indicated below:

Group Claim(s)

- I. 1 through 5; and
- III. 7 and 8.

In Section VIII below, Applicant has included arguments supporting the patentability of the claims as required by M.P.E.P. § 1206.

VIII. ARGUMENTS

1. Are the Group I claims patentable over Mitsuhashi when considered alone or in combination with Katerberg.

In the final Office Action dated December 16, 2002, the Examiner issued a final rejection of each of the pending claims. Claims 1, 3 and 5 were rejected under 35 U.S.C. § 102(e) as being anticipated by Mitsuhashi, claims 2, 4 and 6 were rejected under 35 U.S.C. § 103(a) as being obvious over Mitsuhashi in view of Katerberg.

A. ANTICIPATION

With regard to the rejection under § 102, Appellants submit that this rejection was improper because the Examiner failed to establish a *prima facie* case of anticipation based upon the Mitsuhashi reference.

“A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.” MPEP § 2131, citing Verdegaal Bros. v. Union Oil Co. of California, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). “The identical invention must be shown in as complete detail as is contained in the . . . claim.” Id.,

citing Richardson v. Suzuki Motor Co., 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). Further, the elements must be arranged as required in the claim, although this is not an *ipsissimus verbis* test. Id.

The Cited Reference, Mitsuhashi, Fails To Teach Every Limitation of the Rejected Claims

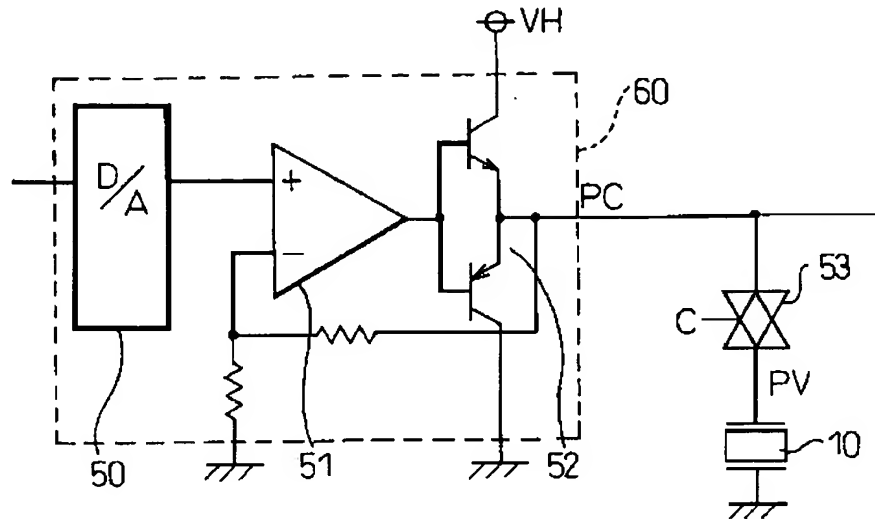
Claims 1, 3, and 5 are independent. Claim 1 recites, *inter alia*:

a feedback loop feeding a terminal voltage applied to said piezoelectric actuators back to a second input of said power amplifier.

Claim 1 explicitly recites the feedback loop being connected such that the terminal voltage of the piezoelectric actuator is presented to the power amplifier. Referring to Figure 1 above, the terminal voltage is the voltage presented to the actuator, specifically , the output of the power amplified less the voltage drop due to the cable R0.

In contrast, Mitsuhashi does not disclose Applicant's feedback loop as explicitly recited in independent claim 1. The feedback loop in Mitsuhashi is the same prior art feedback loop, shown in Applicant's Figure 3. Mitsuhashi does not

disclose a feedback loop that feeds the piezoelectric actuator terminal voltage to the



power amplifier.

Figure 2

As shown in Figure 2¹ above, Mitsuhashi feeds back the voltage output from the drive waveform generating circuit 60 before the voltage drop caused by the connection to the piezoelectric actuator. Mitsuhashi does not disclose feeding back a signal that is reduced by the resistance of the connection to the piezoelectric actuator from the drive waveform generator. Thus, Figure 2 fails to disclose the feedback loop explicitly recited in Applicant's claim 1.

Claim 3 recites, inter alia:

a feedback loop feeding back a terminal voltage of said piezoelectric actuators and said output signal of said power amplifier to a second input of said power amplifier.

¹ Figure 2 is a portion of Figure 5 of Mitsuhashi.

As discussed above, Mitsuhashi fails to disclose a feedback loop feeding back a terminal voltage of the piezoelectric actuator to a power amplifier. Mitsuhashi. Additionally, Mitsuhashi fails to disclose a feedback loop that feeds back a terminal voltage of the piezoelectric actuator and the output of the power amplifier. In Mitsuhashi, the only feedback disclosed is the output of the power amplifier.

As shown in Figure 3² below, Applicant claims a feedback loop that feeds back both a terminal voltage and a power amplifier output.

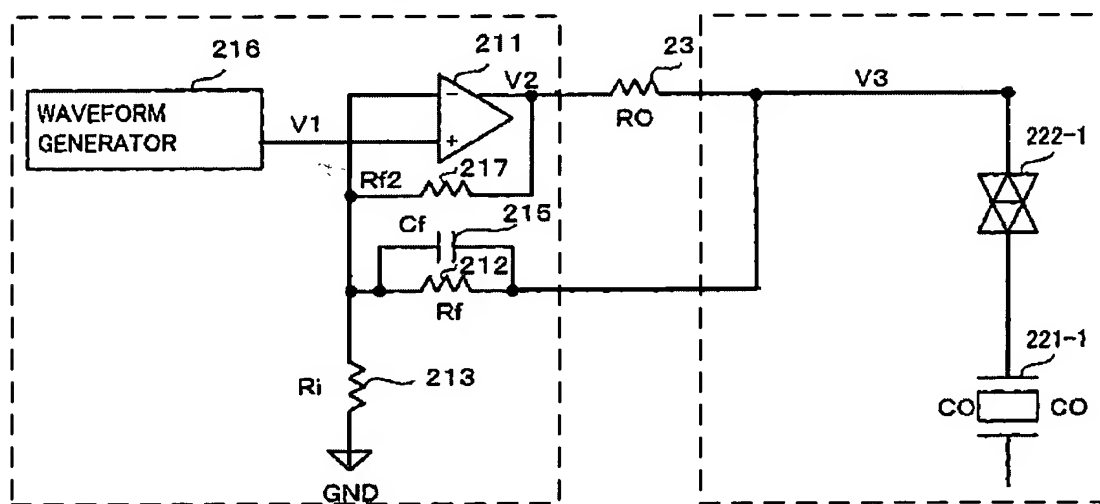


Figure 3

Figure 3 makes it clear that the piezoelectric actuator terminal voltage is different than the output voltage of the power amplifier. Mitsuhashi only utilizes feedback to feed the output of the power amplifier back to the input of the power amplifier. There is no disclosure of feeding the piezoelectric actuator terminal voltage back to

² Figure 3 is a portion of Figure 2 from the present Application.

the power amplifier input. Thus, Mitsuhashi fails to disclose the explicitly recited limitations of claim 3.

Claim 5 is a method claim corresponding to apparatus claim 1. Claim 5 recites, *inter alia*:

feeding said amplified drive waveform signal supplied to said piezoelectric actuators back to a second input of said piezoelectric actuators.

As discussed above with reference to claim 1, and as shown in Figure 1 above, the feedback signal in Applicant's claim is the signal actually input to the piezoelectric actuators, and not the output of the power amplifier. The only signal used as a feedback signal in Mitsuhashi is the output of the power amplifier. Thus, Applicant's explicitly claimed method is not anticipated by Mitsuhashi.

B. OBVIOUSNESS

Paragraph 3 of the Final Office Action rejects claims 2 and 4 as being obvious over Mitsuhashi in view of Katerberg. It is axiomatic that in order to establish a *prima facie* case of obviousness, the Office Action must show that the combination of Mitsuhashi and Katerberg discloses each and every element of claims 2 and 4.

The prior art references must teach or suggest all the limitations of the claim in question. See MPEP § 706.02(j). A reference can only be used for what it clearly discloses or suggests. See In re Hummer, 113 U.S.P.Q. 66 (C.C.P.A. 1957); In re Stencel, 4 U.S.P.Q.2d 1071, 1073 (Fed. Cir. 1987). Here, the references,

whether taken individually or in combination, do not disclose or suggest the invention as claimed by the Applicant.

The Examiner has included Katerberg to in an effort to show additional features present in dependant claims 2 and 4, not to cure the deficiencies in Mitsuhashi discussed above. Whether or not Katerberg actually recites those features, it remains the case that the combination of Mitsuhashi and Katerberg fails to recite each and every limitation of claims 2 and 4.

Claims 2 and 4 depend from, and contain all the limitations of claims 1 and 3 respectively. These dependent claims also recite additional limitations which, in combination with the limitations of claim 1 and 3, are neither disclosed nor suggested by Mitsuhashi and Katerberg and are also directed towards patentable subject matter. Thus, claims 2 and 4 should also be allowed.

2. Does the combination of U.S. Patent 6,334,668 (“Isamoto”) in view of Katerberg, proposed by the Examiner, meet the limitations of the claims?

Claims 7 and 8 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Isamoto in view of Katerberg. The Applicant, however, respectfully submits that the Office Action fails to establish a *prima facie* case of obviousness with respect to claims 7 and 8.

The prior art references must teach or suggest all the limitations of the claim in question. See MPEP § 706.02(j). A reference can only be used for what it

clearly discloses or suggests. See In re Hummer, 113 U.S.P.Q. 66 (C.C.P.A. 1957); In re Stencel, 4 U.S.P.Q.2d 1071, 1073 (Fed. Cir. 1987). Here, the references, whether taken individually or in combination, do not disclose or suggest the invention as claimed by the Applicant.

Claim 7 recites, inter alia:

a cable connecting said control circuit board and said intermediate circuit board to each other; and

a negative feedback loop including a resistor and a capacitor, said negative feedback loop provided between said power amplifier included in said control circuit board and inputs of said transfer gates included in said intermediate circuit board.

Claim 8, depends from and includes all the above limitations of claim 7.

The Examiner asserts Isamoto discloses all of the elements as recited in claim 7 except a negative feedback loop including a resistor and a capacitor. Applicant disagrees with this reading of Isamoto. The Examiner has mixed and matched various portions Isamoto in a manner that would not work and then included Katerberg, which still does not disclose Applicant's explicitly claimed invention.

The prior art shown in Figure 12 of Isamoto is improperly combined with the improvement shown in Figures 8 and 11. Figure 12 of Isamoto shows a main

unit 2 that contains a waveform generating circuit 80. The generated waveform is transmitted to the recording head 10 (inkjet head) via a flexible wiring board 100. There is no feedback shown in Figure 12 between the recording head 10 and the main unit 2. Figure 12 of Isamoto is similar to Applicant's prior art Figure 3.

Isamoto solves the problem inherent in its Figure 12 by having the waveform generating circuit 80 formed in the recording head 10. With the waveform generating circuit 80 being part of the recording head 10, the signals are not output via the long flexible wiring board 100. Thus, there is no distortion due to the parasitic inductance, etc., of the flexible wiring board. See, Isamoto, col. 12, lns. 17-32. As such, there would be no reason to include any feedback to improve the drive signal presented to the piezoelectric actuator terminal because, due to the proximity of the waveform generating circuit, there would be no signal degradation.

The Examiner admits that Isamoto fails to disclose the negative feedback loop provided between the transfer gates on the intermediate circuit board and the power amplifier on the control circuit board as required by each of claims 7 and 8. The Examiner asserts, however, that Katerberg cures Isamoto's deficiency in this regard. The Applicant respectfully disagrees.

Katerberg only discloses a feedback loop that feeds the voltage signals output by piezoelectric elements 12 and 22 back to power amplifiers 28. Katerberg does not show a feedback loop provided between a transfer gate and a power amplifier. In fact, Katerberg does not show a transfer gate at all. In Katerberg, the driving voltage is applied directly to driving piezoelectric elements 18. Moreover, even if one were to assume that the voltage applied to the input of a driving piezoelectric elements 18 would be same as a voltage applied directly to the input of a transfer gate, Katerberg still fails to show a feedback loop provided between the input to the driving piezoelectric elements 18 and the power amplifiers 28 as required by claims 7 and 8.

Further, even if Katerberg cured the deficiencies present in Isamoto discussed above, which it does not, one skilled in the art would not be motivated to combine Isamoto with Katerberg. As discussed above, Isamoto does not suffer from a dulled signal because the waveform generating circuit is part of the recording head 10. As such, there is no reason to perform any signal conditioning on the apparatus disclosed by Isamoto.

For all of the reasons discussed above, Applicant believes the pending claims are allowable and requests reversal of the Examiner's rejections.

IX. CLAIMS INVOLVED IN THE APPEAL

A copy of the claims involved in the present appeal is attached hereto as Appendix A.

Dated: October 22, 2003

Respectfully submitted,

By 

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APPENDIX A

Claims Involved in the Appeal of Application Serial No. 10/050,539

1. A drive circuit for an ink jet head having nozzles, pressure generating chambers filled with ink to be discharged from said nozzles, and piezoelectric actuators corresponding to respective pressure generating chambers, said ink jet head discharging ink droplets from said nozzles by changing volumes of said pressure generating chambers in response to a drive waveform signal applied to said piezoelectric actuators, said drive circuit comprising:

a waveform generator generating said drive waveform signal;

a power amplifier amplifying said drive waveform signal supplied to a first input of said power amplifier and outputting said drive waveform signal to said piezoelectric actuators; and

a feedback loop feeding a terminal voltage^{where} applied to said piezoelectric actuators back to a second input of said power amplifier.

2. The drive circuit of claim 1, wherein said feedback loop includes a capacitor producing a lead to phase signal in a high frequency range.

3. A drive circuit for an ink jet head having nozzles, pressure generating chambers filled with ink to be discharged from said nozzles, and piezoelectric actuators corresponding to respective pressure generating chambers, said ink jet head discharging ink droplets from said nozzles by changing volumes of said

pressure generating chambers in response to a drive waveform signal applied to said piezoelectric actuators, said drive circuit comprising:

a waveform generator generating said drive waveform signal;

a power amplifier amplifying said drive waveform signal supplied to a first input of said power amplifier and outputting said drive waveform signal to said piezoelectric actuators; and

Fig. 3 { a feedback loop feeding back a terminal voltage of said piezoelectric actuators and said output signal of said power amplifier to a second input of said power amplifier. 77

4. The drive circuit of claim 3, wherein said feedback loop includes a capacitor producing a lead to phase signal in a high frequency range.

5. A method of driving an ink jet head, said ink jet head having nozzles, pressure generating chambers filled with ink to be discharged from said nozzles, and piezoelectric actuators corresponding to respective pressure generating chambers, said ink jet head discharging ink droplets from said nozzles by changing volumes of said pressure generating chambers in response to a drive waveform signal applied to said piezoelectric actuators, said method comprising the steps of:

generating said drive waveform signal;

inputting said drive waveform signal to a first input of a power amplifier to produce an amplified drive waveform signal, and supplying said amplified drive waveform signal to said piezoelectric actuators; and

feeding said amplified drive waveform signal supplied to said piezoelectric actuators back to a second input of said piezoelectric actuators.

6. Cancelled.

7. A drive circuit for an ink jet head of a serial type ink jet printer, the ink jet head including a carriage, nozzles, and pressure generating chambers filled with ink, wherein said ink jet head discharges ink droplets from the nozzles by changing volumes of said pressure generating chambers in response to a drive waveform signal applied to piezoelectric actuators corresponding to said pressure generating chambers while moving said carriage reciprocally in a direction perpendicular to a feeding direction of a printing sheet, said drive circuit comprising:

a control circuit board including a waveform generator generating a signal for driving said ink jet head, a power amplifier amplifying the output signal of said waveform generator, an image memory storing printing data, and a data transmitter transmitting image data stored in said image memory as serial data thereon;

an intermediate circuit board mounted on said carriage, said intermediate circuit board including a data receiver receiving said serial data from said data transmitter, transfer gates selecting piezoelectric actuators on the basis of said received printing data, and a level shifter matching voltage levels from said data receiver to respective transfer gates;

a cable connecting said control circuit board and said intermediate circuit board to each other; and

a negative feedback loop including a resistor and a capacitor, said negative feedback loop provided between said power amplifier included in said

control circuit board and inputs of said transfer gates included in said intermediate circuit board.

8. The drive circuit of claim 7, further comprising a negative feedback loop including a resistor, said negative feedback loop being provided between an output and an input of said power amplifier mounted on said control circuit board.